

Gas Hydrates - United States Perspective



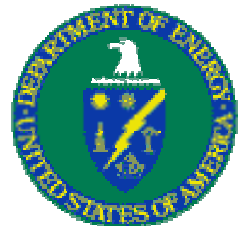
Future Natural Gas Supplies
for Increased Demand

Presented by:

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Office of Natural Gas & Petroleum Technology

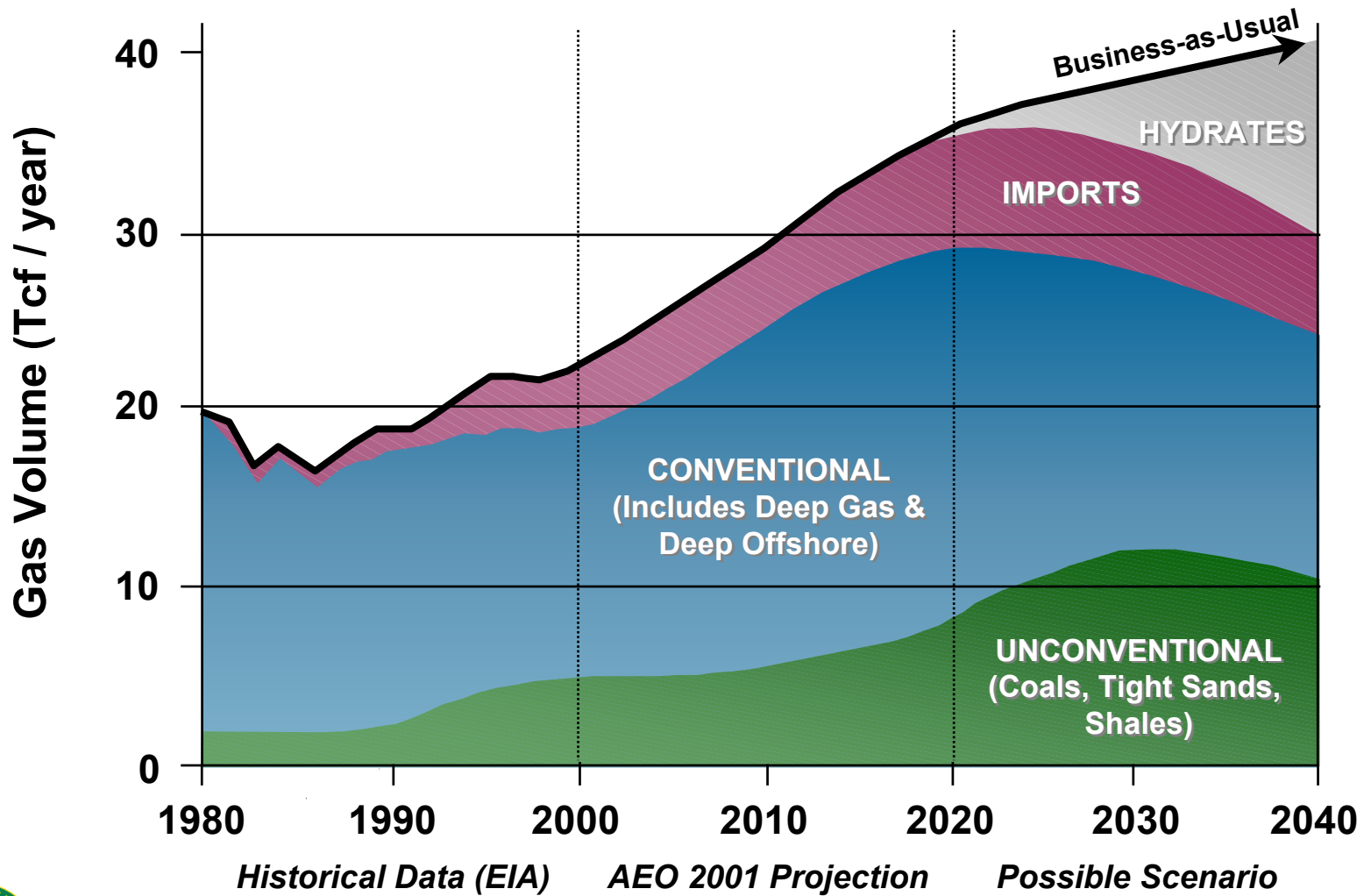
U.S. Department of Energy



U.S. Department of Energy Hydrate R&D Program

Goal: Develop technologies necessary to allow commercial production of methane from hydrates by 2015, and address associated environmental and safety issues.





Sources: NETL, Boswell



U.S. Department of Energy

Estimated North American Resource Potential

North Slope Alaska:

590 Tcf (USGS, 1995)

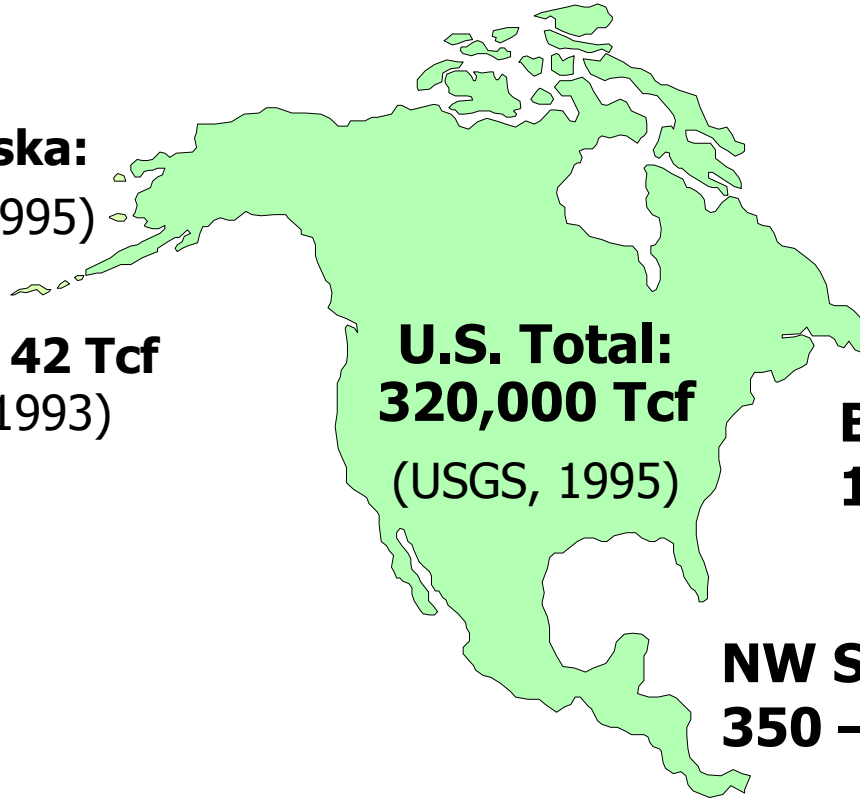
- Prudhoe Bay: 42 Tcf
(Collett, 1993)

- Tarn: 60 Tcf

U.S. Total:
320,000 Tcf
(USGS, 1995)

Blake Ridge:
1,300 Tcf (Collett, 2000)

NW Slope, Gulf of Mexico:
350 – 500 Tcf (Sassen, 2001)



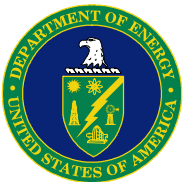
Hydrate R&D Program Areas

Resource Characterization: Define location, sedimentary relationships and physical properties

Production: Develop and field test technology necessary for commercial production

Safety & Seafloor Stability: Ensure safety of oil and gas recovery through or near hydrates

Global Carbon Cycle: Understand impact of hydrates and their production on global carbon



U.S. Program Elements

- **Laboratory Studies:** Pure hydrates and hydrate-sediment systems
- **Field Studies:** Alaska and Canadian Arctic; Gulf of Mexico; Blake Ridge; ODP
- **Improved Sampling and Imaging Tools:** Monitoring systems, new seismic, core recovery tools
- **Model and Database Development:**

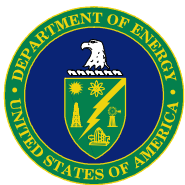
www.hydrate.org



U.S. Gas Hydrate R&D Budgets

U.S. Government funding in FY 2001 –\$15.33 million

- Department of Energy
 - FY 1999: \$500,000
 - FY 2000: \$3,000,000
 - FY 2001: \$9,703,000
 - FY 2002: \$9,800,000
- Other U.S. Government Agencies (2001 funding)
 - U.S. Geological Survey \$1.3 million
 - Minerals Management Service \$0.6 million
 - Naval Research Lab \$1.38 million
 - NOAA \$0.6 million
 - National Science Foundation \$1.75 million



Participants in DOE Hydrates R&D

- Universities
- Exploration and Production Companies
- National Laboratories
- Oil Field Service Companies
- Other Government Agencies
- Ocean Drilling Program
- International Cooperation



Multi-Agency Coordination

- Department of Energy
- U.S. Geological Survey
- Minerals Management Service
- Naval Research Lab
- National Science Foundation
- National Oceanic and Atmospheric Administration



National Laboratory Studies



- National Energy Technology Laboratory oversees program, maintains databases & conducts thermodynamic studies
- Numerical Simulation & lab measurements of dissociation and thermodynamics (Berkeley)
- Sea-Floor Process Simulator: thermal transport properties and phase transformations (Oak Ridge)



Gulf of Mexico Hydrate Studies

Goals: understand hydrate role in seafloor stability & determine feasibility for methane production

- High resolution seismic, sampling, and well logging
- Joint Industry Projects started October 2001
- National Lab and University projects started 2000 and 2001



Multi-Component Seismic, University of Texas at Austin

Goal: predict sediment stability in areas of hydrate accumulation

- Industry 4-component/3-dimensional seismic
- Define P-wave/S-wave attributes for improved hydrate detection and quantification
- Correlate P/S data to geotechnical studies and hydrate samples



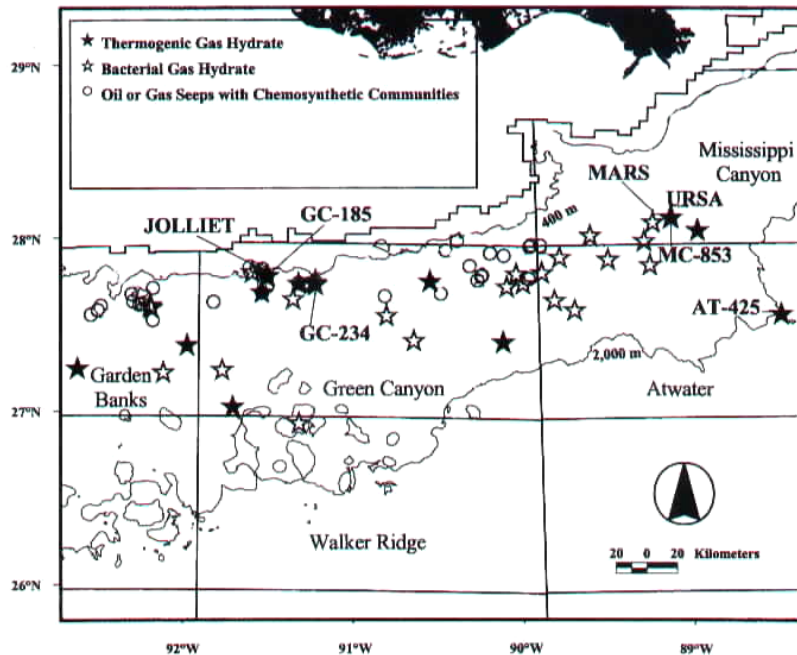
Gulf of Mexico Hydrate Research Consortium, University of Mississippi

Goal: improved understanding of hydrate role in seafloor stability

- Focus on hydrocarbon flux, microbial involvement
- Laboratory studies and sensor development leading to Hydrates Monitoring Station
- Early finding: bacterial surfactants accelerate hydrate formation



Applied Hydrate Research, Texas A&M University



- DSDP, piston cores & submersible samples
- Hydrates contain thermogenic and bacterial methane and heavier hydrocarbons
- 440–2400m water depth
- Areal extent 23,000 sq. miles (59,000km²)



Planned Gulf of Mexico Joint Industry Projects

- Chevron- improve hydrate measurement capability of seismic, MWD, logging and core
- Halliburton – develop hydrates reservoir production simulator
- Scripps Institute – seafloor sampling and monitoring to define processes responsible for formation, dissociation
- Joint Oceanographic Institutions – develop improved hydrates coring and sampling tools



US Geological Survey Arctic Studies

- Goal: quantify North Slope hydrate accumulations and design production test
- W. Prudhoe Bay
 - Cores, logs & production test in one well, log evidence of hydrates in 50 wells
 - Seismic and log evidence of underlying free gas
- Tarn- multiple hydrate-bearing sandstones with underlying free-gas zone



2001 Joint Industry Projects

Alaska North Slope

1. BP Exploration

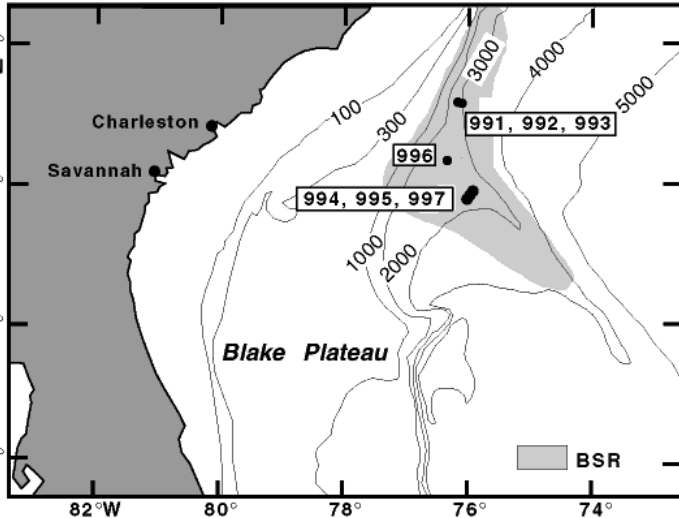
- Characterize and determine commercial viability of recovery from hydrates and underlying free gas zones
- Eileen area, Prudhoe Bay, Kuparuk River and Milne Point Units

2. Maurer Technology

- Evaluate best existing technologies to produce methane from hydrates
- South of Prudhoe Bay Unit and Brooks Range Foothills



Blake Ridge Studies



- Blake Ridge - sediment drift accumulation, in 2600m water off SE United States
- Extensive database – DSDP/ODP coring 1970, 1980, 1995, conventional, deep-tow, and high resolution seismic and VSP
- Current Studies – origin of collapse feature, seismic estimates of hydrate concentration, methane flux



Hydrate System Biology

- NOAA – Deep East Exploration dives
- MBARI – Hydrates for CO₂ Sequestration
- ODP leg 204 – Hydrate Ridge



International Cooperation

- Important to the DOE and other government agencies
- Mallik Well
- Hydrate Ridge
- Bilateral Information Exchanges

